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Aluminum Rolling Mill Lubrication

By E. M. KIPP* and H. L. HARPER†

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Aluminum rolling mills may be broadly classified into three general categories:

- (a) Blooming and sheet ingot break-down mills. These are all hot rolling mills.
- (b) Continuous mills for hot rolling sheet and merchant mills for hot rolling rod and structural shapes.
- (c) Mills for cold rolling sheet and foil.

Often aluminum rolling mills are even more broadly classified as hot rolling mills and cold rolling mills.

In considering the lubrication requirements of aluminum rolling mill equipment, we find the assumption frequently made that the unit loads encountered in aluminum rolling mills are appreciably lower than those for steel because of the "soft" nature of aluminum metal. This is not the case, however, and the unit pressures encountered in the rolling of aluminum alloys are often not only as great as those operative in rolling steel, but may be even greater. Thus, for comparable hot rolling operations of aluminum alloys, we may require a ratio of 1.4 to 1 h.p. relative to steel with proportionate increases in unit bearing loads. This is due primarily to the fact that the deformation strength for many aluminum alloys, when at the temperatures employed in alu-

minum hot rolling, is considerably greater than that of steel at the temperatures employed in hot rolling steel. Also, during hot rolling operations aluminum has a marked tendency to adhere and stick to the steel rolls during the rolling operation. This tendency of aluminum to stick to the hot rolls greatly increases the resistance to slippage of the aluminum against the steel rolls during reduction, resulting, in turn, in the need for higher unit deformation loads. Thus, the roll neck bearings in some of our modern hot mills must withstand a total applied pressure much greater than for steel rolling. Unit bearing pressures of 1500 to 2000 lbs./sq. in are frequently operative with intermittent shock overloads of from 100 to 200%.

An increasing proportion of our modern mills are equipped with either roller bearings or anti-friction bearings of the Morgoil types. Before 1939, a large number of mills were still in operation which employed the plain open type journal bearings; these were either bronze bearings with babbitt inserts or plain babbit bearings. Since 1939, practically all of these mills have been equipped with bearings of the bonded resin type. These are of simple design, easily and quickly handled both in installation and in inspection. Likewise, their general condition can be readily determined by the millwright with little more than a passing glance.

In the case of the older mill equipment employing these types of bearings for the work rolls, satisfactory lubrication has been obtained in most instances with the common type of hard block greases. An exception is the resin-type bearing which is lubricated with a soluble oil water emulsion. A typical

block grease used successfully on some of our hot mills is a lime soap-base grease having a melting point of 105-115°C. and an unworked penetration of from 30 to 40. Variations of this grease include the addition of tallow and graphite.

In the case of cold rolling mills, a soda-base grease having a melting point of 125°C. and an unworked penetration of from 30 to 40 has been used successfully. Still a third type of roll neck grease which has been used in the lubrication of open roll neck bearings on some of our hot mills is a lime-base water resistant grease blended with 4% of lead oleate as an extreme pressure additive and with 17% tallow as an oiliness additive. Incidentally, as originally used, this grease contained a considerable amount of graphite. Later tests in which the graphite was not included indicated that the performance of the grease was not adversely affected in any apparent way.

As indicated previously, many of our newer mills are no longer equipped with the open type plain journal bearings but employ, instead, fully enclosed roller or anti-friction journal type bearings. On the 4-High mills in which two of the rolls perform as back-up rolls and two perform as work rolls, the work rolls are fitted with roller bearings, while the back-up rolls are either of the Morgoil or roller bearing types. In the lubrication of the Morgoil type bearings, successful use is made of any good grade mineral oil of the proper viscosity. The roller bearing types, however, are grease lubricated and employ a heavy duty lime-base extreme pressure type grease.

The gear drives and pinion stands are lubricated with high viscosity E.P. mineral

* E. M. Kipp, Aluminum Research Laboratories, Aluminum Co. of America, New Kensington, Pa.

† H. L. Harper, Mech. Eng. Dept., Aluminum Co. of America, Pittsburgh, Pa.



oils of the lead-soap type. This lubricant serves both the gears and the journal bearings.

The lubrication of the screw-downs does not present a problem which is peculiar alone to the aluminum rolling industry as it is quite analogous to similar operations in steel rolling, for example. We have in operation at the present time two types of screw-down equipment—that which is fully enclosed and motor driven, and that in which the gears are exposed and which are, in turn, hand-operated. In the case of the former, a good grade of straight mineral oil has been used satisfactorily in light duty operation; extreme pressure lubrication is required for heavy duty operation. In the lubrication of the open type screw-down gears, a heavy asphaltic type gear oil has provided satisfactory performance.

The lubrication of the contact area between the journal of the rolls and the roller bearing bore presents a rather difficult problem. This area is under extremely heavy load and slip must be provided. It has been found, in operation, that the inner roller race will gradually slip about the journal. If attempts are made to stop this slippage by keying the race into place, it has been found that the entire bearing and housing are seriously damaged. As the inner roller race will tend to slip in the journal bearing housing at rather slow speeds and under heavy loads, considerable scoring occurs with subsequent ill effects. At present this area is being lubricated with a heavy paste of microfine graphite suspended in a heavy mineral oil. This material has not proved entirely satisfactory.

Couplings used in the operation of rolling mills are presently lubricated with either mineral oils containing lead-soap as an E.P. agent or with a soda-fiber type grease. The coiler rolls which are used in coiling sheet are, for the most part, oil lubricated. This is true both on hot coiling and on cold coiling. Motor driven rollers on some of our mill run-out tables are lubricated with a high temperature soda-base type grease possessing a high melting point. The temperature of these rollers, resulting from their contact with the hot metal, is apt to become as high as 400-500°F. For this reason it was deemed necessary at the time to use a soda-base type grease. However, trouble was encountered with this type of grease because of contamination from soluble oil which entered the bearings and washed out the grease. This problem was solved mechanically by maintaining a low pressure of air in the

rolls, acting as a seal to exclude the soluble oil. More recently, the design of the motor driven rollers has been improved, and soluble oil contamination is no longer a problem.

Finally, in connection with the immediate operations of the rolling mills, there are a large number of miscellaneous grease fittings and these are lubricated with a good grade of lime-base type cup grease of the proper consistency.

GENERAL DISCUSSION

The foregoing indicates in a brief and general manner the primary considerations affecting lubrication requirements for our aluminum rolling mill equipment. While satisfactory performance is, in general, now being obtained with the present greases used, we do not intend to imply that, as users or potential users of industrial greases, we feel no further room for improvement exists. For one thing, we find ourselves confused by the large number and the variations in individual greases available even from a single manufacturer. In attempting to determine the specific technical advantages and disadvantages of each type, particularly with reference to field performance characteristics, we frequently obtain the impression that the primary reason for the variations in composition of these greases is that of providing talking points for the seller of the grease. In this connection we feel that the users may also be at fault at times in demanding specific compositions and variations, the need for which is based primarily upon personal opinions and prejudices rather than upon sound engineering data.

The large number of available greases also has another important practical implication both to us as users, and to you as manufacturers, in that in the absence of dependable methods of laboratory evaluation for predicting with reasonable accuracy the probable performance characteristics of these various greases, it is virtually impossible for the user to be certain that is indeed using the best available grease for the particular application without testing under actual operating conditions all of the available greases. This obviously is not practical. A further disadvantage is that whenever operating trouble is experienced and the grease or lubricant is blamed for this trouble, it is difficult and sometimes impossible to refute or to substantiate the claim, with the result that where the trouble may have been a mechanical or engineering one, it frequently escapes detection in the confusion of the argument regarding the relative merits of the various proprietary greases. Also, a

good or even a superior grease may thus be discarded in favor of one not so appropriate.

Our present interest lies in securing the minimum number of different greases compatible with the best lubrication obtainable for our mechanical equipment. Thus, while we are in sympathy with the goal of the development of all-purpose greases, we are not inclined to sacrifice performance simply in the interests of obtaining a single all-purpose grease. In this connection our greatest interest is in the development of greases with improved properties such as extreme resistance to the combined effects of high temperature and water contamination, bleeding, channeling, superior metal wetting characteristics (particularly on hot metal), and improved load bearing and wear resistance characteristics. Our present lubrication difficulties can be traced directly to the fact that our present greases are deficient in one or more of these characteristics.

Bleeding has been a particular problem, for instance, in our hot rolling mills. In cases where adequate seals are difficult to provide, the separated oil frequently wets out and contaminates the rolls with resultant damage to metal quality. Likewise, while we seldom encounter the cases of short bearing life characterizing some of the steel rolling mill case histories, we nevertheless feel that our bearing performance can be greatly improved through improved lubrication. In this latter case we are of the opinion that laboratory test methods employing apparatus such as the Shell 4-Ball, Timken, Falex, etc., are worthy of greater study, particularly under conditions where the various types of laboratory data obtainable with this equipment can be correlated and checked with field performance. We feel that this type of apparatus has been prematurely and perhaps unwisely condemned in some instances because of the several known cases whereby one machine may rate a given series of oils in a different order than that obtained with another type of lubricant testing machine. We likewise feel that much of the future development work in improving greases will necessarily center around a better understanding of the role played by the various types of extreme pressure addition agents and of the complex temperature-pressure-shear rate-flow characteristics of grease systems. In attaining these goals we realize that the users and the manufacturers of lubricants must cooperate closely in carrying out and evaluating one another's suggestions and in maintaining at all times an open mind with respect to this general problem.

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Ford started post-war production with completion of the first car at 10:50 a. m. July 3 at the River Rouge plant in Dearborn, Mich. Nash has announced that the 1946 model has been completed, and is expected to go into assembly line production within a few months.

Other manufacturers are expected to get into production shortly, when materials and other situations are solved. Indications now point to an announcement from General Motors and Chrysler in the early fall.

Resumption of car production calls for the latest information on lubricants and lubrication procedure so those in the field can service these cars properly when they appear at service stations.

While the general public is eager for facts about new cars as to features of appearance and of the engine, the oil industry has checked to find changes in lubrication requirements over 1942 models are few.

At present, however, the oil industry is deeply concerned with the question of "Heavy Duty" type Motor Oil and its relation to passenger car and truck service. New production along with new recommendations and new service manuals make the situation a timely one.

FORD

Mechanical features of the 1946 models are:

Engine, V-8 100 hp, pre-war V-8 was 90 hp.

Pistons, aluminum with 4 rings are standard equipment.

Shock absorbers, improved oil seals to prevent fluid loss.

Bearings, tri-alloy consisting of lead, silver, iron and copper; replaces cadmium bearings.

Brakes, require less pedal pressure, easier to adjust, feature a floating type shoe that seats itself. Easy accessibility to fluid reservoir in master unit.

Cooling system, radiator pressure cap maintaining 5 lb. constant pressure.

Fuel pump, sediment bowl added.

Camshaft timing gear, aluminum.

Cleaner, oil-bath air cleaner standard equipment.

Valves, alloy steel inserts for intake and exhaust valves, position moved to provide better cooling.

Oil pump, enlarged to circulate greater volume of oil at a higher pressure.

Spark plug cables protected by plastic sleeves.

Distributor, has a dead-air chamber between terminal housing and cap which prevents condensation. Improved winter starting.

Rubber, synthetic used for virtually all rubber parts.

Lubrication, no change in lubricants or capacities.

Spring covers, on Super DeLuxe models only, equipped with fittings (see Chart on opposite page).

Rear wheel bearing lubrication, through fittings.

Crankcase ventilation, air comes through air cleaner. Reports are that aluminum material still is under test by Ford laboratories as to possible corrosion.

The 6 cyl. Ford is to be produced later, with an engine developing 90 hp at 3,300 rpm. It also will have aluminum pistons with 4 rings, improved distributor, and the exhaust manifold has been redesigned away from the fuel pump to eliminate vapor lock.

NASH

Two models are announced for the 1946 line. They are the new Nash "600" in the low-priced field, and the long established Ambassador in the medium-priced bracket.

The "600" will have a new front end suspension, with individual coil spring suspension on all four wheels for better steering, improved road-ability, and easier riding.

MERCURY

Features have been announced, with production 30 to 90 days after the first Fords. The 1946 models are to have tri-alloy bearings, crankcase ventilation, improved oil pump, aluminum pistons with 4 rings, interchangeable cylinder heads, and oil filter air cleaner and oil cleaner as standard equipment.

Three Kinds of Motor Oil

1. Regular Motor Oil
2. Premium Motor Oil
3. Heavy Duty Motor Oil

Three kinds of motor oil will be available to the operators of automotive vehicles. They are designed to provide maximum performance for each type of internal combustion engine and the fact that definite specifications have not been set up permits further progress and improvement. The oils are referred to and recommended by types only.

REGULAR MOTOR OIL

This term shall be used to designate a straight mineral oil. Oils of this type are generally suitable for use in internal combustion engines under moderate operating conditions.

PREMIUM MOTOR OIL

This term shall be used to designate an oil having proved oxidation stability and bearing corrosion preventive properties. Oils of this type are generally suitable for use in internal combustion engines where operating conditions are such that regular oils do not give satisfactory service.

HEAVY DUTY MOTOR OIL

This term shall be used to designate an oil having proved oxidation stability, bearing corrosion preventive properties, and detergent dispersant characteristics. Oils of this type are generally suitable for use in both High Speed Diesel and gasoline engines under heavy duty service conditions.

These definitions have been recommended to and approved by the General Committee, Division of Marketing, American Petroleum Institute on July 17, 1945 and are immediately being transmitted to Motor Car Manufacturers with the suggestion that such designations be used in Instruction Books. Whatever action each Motor Car Manufacturer takes on this will be reported in further bulletins.

In his letter to motor car manufacturers, L. C. Welch, Chairman of the Lubrication Committee of the American Petroleum Institute, says:

"The General Committee, Division of Marketing supported the Lubrication Committee in its conclusion that all reputable marketers of Motor Oils will be very anxious to have their Premium Motor Oils in accordance with the most accepted requirements from a product quality standpoint; in fact, the competition will force that situation. On the other hand, there are many manufacturers and marketers of Motor Oils who are of the opinion that they can produce better Premium Motor Oils for passenger car service than those marketed in conformity with the heavy duty requirements of U. S. Army 2-104B and U. S. Navy 9000 Series specifications.

"It is hoped that in the issuance of new motor car instruction books for passenger cars, it will be unnecessary to recommend and therefore to discuss the application of Heavy Duty Motor Oils for passenger car service.

"We trust that the program as approved will be satisfactory to the point where it may be used as a basis for starting the various programs involved with the understanding that as we in both industries proceed, it may be subject to change and revision depending upon conditions."

* * *

In the API description of Motor Oils, the Regular Oil is described as a straight mineral oil but it is assumed that it may contain additive ingredients such as pour point depressant, etc.

Likewise, Premium Oil is described as having proved oxidation stability and bearing corrosion preventive properties. However, this does not preclude its also possessing detergency quality, provided by additives.

For the time being, there is a restriction on the use of detergent type additives containing critical materials in oils for passenger car service as covered by PAW Recommendation No. 40.

Following are the preliminary reports obtained by Field Engineers as a matter of current interest, subject of course to final decisions of the manufacturers and the actual statements in the manuals:

CHEVROLET—A caution against use of the Heavy Duty type is likely to be included in the 1945 Passenger Car Owner's Manual with no specific mention of the other grades but recommending SAE grades. Caution on Heavy Duty type is expected to inform motorists on what steps should be taken if this type is used. The new Truck Owner's Manual, to be issued around the first of the year, may contain a recommendation based on type.

FORD (U. S. and Canada)—Will recommend Regular type only in passenger cars.

CHRYSLER (Plymouth, Desoto, Dodge, Chrysler)—Plan to recommend Regular and Premium types for all passenger cars.

CHRYSLER (Canada) — Recommendations likely to be Regular and Premium types for all cars.

HUDSON—Regular type likely to be recommended in first owner's manuals, with recommendation of Premium type depending on tests now under way.

PONTIAC—Probably will recommend Regular and Premium types. Undecided on including caution on use of Heavy Duty type.

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Manufacturers' Recommendations on Three Types of Motor Oils

Automobile manufacturers have been considering the three types of Motor Oil approved by the petroleum industry, and studying what statements can be made to motorists through recommendations in forthcoming passenger car owner's manuals.

These oils are the Regular, Premium, and Heavy Duty types defined by the American Petroleum Institute Lubrication Committee and approved at a recent meeting of the General Committee, Division of Marketing, American Petroleum Institute.

BUICK—Will use Regular and Premium types. If Heavy Duty type is mentioned it will be as a caution to car owners not to use this type in passenger car engines.

STUDEBAKER—Engineering Department is considering the types.

PACKARD—Will likely recommend Regular and Premium types.

CADILLAC—Will recommend use of Regular and Premium types, with wording such as "For protection for Cadillac engines, Premium Oil is recommended." No

mention is to be made of Heavy Duty type.

WILLYS—Will recommend use of Regular and Premium types for all passenger car lines. May recommend use of Heavy Duty type in jeep when subjected to heavy work, resulting in high operating conditions.

OLDSMOBILE—May recommend use of Regular and Premium types. Considering a caution on use of Heavy Duty type. Manual may carry explanation of what is moderate, intermediate, and heavy duty operating conditions.

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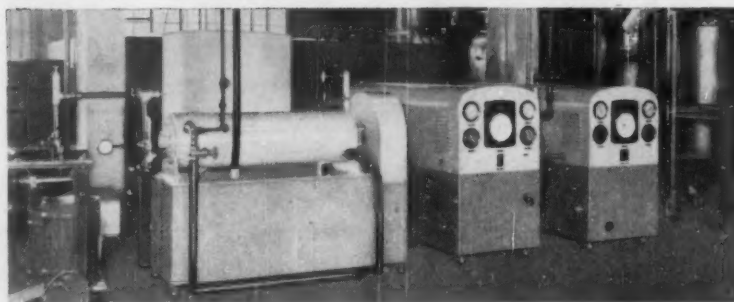
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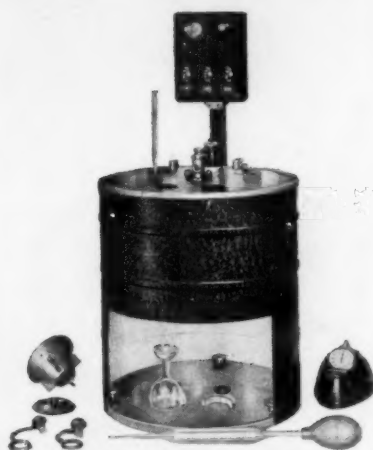
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